DEPARTMENT OF ELECTRONICS AND ELECTRICAL COMMUNICATION ENGINEERING (EEC)
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EEC4122: Satellite Communication Systems (Fall 2015)
Chapter 3: The Geostationary Orbit

Problem Set

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P1: (a) Explain why there is only one geostationary orbit.

(b) Show that the range d from an earth station to a geostationary satellite is given by

$$d = \sqrt{(RsinEl)^2 + h(2R+h)} - RsinEl,$$

where R is the earth radius (assumed spherical), h is the height of the geostationary orbit above the equator, and El is the elevation angle of the earth station antenna.

P2: Determine the latitude and longitude of the farthest north earth station which can link with any given geostationary satellite. The longitude should be given relative to the satellite longitude, and a minimum elevation angle of 5° should be assumed for the earth station antenna. A spherical earth of mean radius 6371 km may be assumed.

P3: An earth station is located at latitude 35°N and longitude 100°W. Calculate the antenna-look angles for a satellite at 67°W.

P4: Calculate for your home location the look angles required to receive from the satellite

(a) immediately east and (b) immediately west of your longitude.

P5: An earth station at latitude 30°S is in communication with an earth station on the same longitude at 30°N, through a geostationary satellite. The satellite longitude is 20° east of the earth stations. Calculate the antenna-look angles for each earth station and the round-trip time, assuming this consists of propagation delay only.

P6: Determine the maximum possible longitudinal separation which can exist between a geostationary satellite and an earth station while maintaining line-of-sight communications, assuming the minimum angle of elevation of the earth station antenna is 5°. State also the latitude of the earth station.

P7: Calculate the angle of tilt required for a polar mount antenna used at your home location.

P8: The borders of a certain country can be roughly represented by a triangle with coordinates 39°E, 33.5°N; 43.5°E, 37.5°N; 48.5°E, 30°N. If a geostationary satellite has to be visible from any point in the country, determine the limits of visibility (i.e., the limiting longitudinal positions for a satellite on the geostationary arc). Assume a minimum angle of elevation for the earth station antenna of 5°, and show which geographic location fixes which limit.